

XII.—*Some preliminary remarks on the Velocity of Migratory Flight among Birds, with special reference to the Palearctic Region.* By Colonel R. MEINERTZHAGEN, D.S.O., M.B.O.U., F.Z.S.

THE question arises at once as to whether migratory flight is of a different nature to daily flight in search of food or to escape enemies. We have some interesting opinions on this subject. Gätke tells us that the speed of birds during their daily locomotions in the air has not an approximate relation to the wonderful velocity of flight attained by them during their migrations. He accounts for such enormous speed by the fact that birds migrate in the more elevated layers of the atmosphere, in which more uniform conditions prevail, and which are less subject to powerful meteorological disturbances.

Cooke ('Bird Migration'), on the other hand, thinks that migrating birds do not fly at their fastest. He believes that their migrating speed is usually from 30 to 40 miles an hour, and rarely exceeds 50. Flights of a few hours at night, alternating with rests of one or more days, make the spring advance very slow. He goes on to say that during day-migration the smaller land-birds seldom fly faster than 20 miles per hour, though larger birds move somewhat more rapidly.

I believe Gätke's theory to be based on faulty evidence, as I hope to show later. Moreover, birds would experience greater difficulties in flying in the "more elevated layers of the atmosphere," as the atmosphere is rarer and therefore offers a less suitable mixture on which their wings can beat. They would experience the same difficulties as a man trying to swim in froth.

My own observations tend to show that migratory flight differs very little in its velocity from the flight of daily movement, and I see no reason why it should or how it can be so. I believe migratory flight to be steady and unhurried, and

that birds only fly at their fastest when pursuing or when pursued. Anyone who has watched a Falcon being flown at a Rook will be struck by the speed which the usually leisurely-flapping Rook can attain from the moment he realizes he is the quarry.

I have seen Rooks travelling on migration, and accurate observation gives their pace as from 38 to 40 miles per hour. Now these migratory Rooks were travelling in their usual leisurely fashion, and not at anything like the speed they can use when attacked by a Falcon. All other migrations which I have witnessed in many and various parts of the world confirm my belief that migratory flight differs in no way from every-day movement, except that it is steadier and possibly a trifle slower.

So in dealing with this question, I shall consider estimates of any normal flight as the normal velocity which birds attain on migration. That birds can hurry I do not doubt, but such effort could not be long sustained, and would be of little use to them in the long-distance migratory journeys they are accustomed to take.

I shall first deal with those estimates of velocity, which previous writers have recorded, but which cannot be regarded as reliable. Gütke claims that Hooded Crows fly at 108 miles per hour and, Bluethroats at 180 whilst on passage, and especially in the spring. He claims that Bluethroats pass from between 10 and 27 degrees of northern latitude to the 54th degree of northern latitude in nine hours. He also assumes that the American Golden Plover takes but fifteen hours from Labrador to northern Brazil, supporting this theory by his personal observations on Godwit and Curlew covering over 7000 yards in sixty seconds, or at the rate of over 4 miles a minute!

His estimate of Hooded Crow flight is based on the assumption that their line of flight is from east to west over Heligoland, and that they make for the east coast of England. This apparently is not the case, for their line of autumnal flight over Heligoland is from north-east to south-west, and these are probably not the birds which

arrive in such numbers on our central east coast. The Bluethroat estimate is based on the assumption that birds fly direct from Egypt to Heligoland in one night, which is certainly not the case. His estimate of the flight of Godwit and Curlew, on which he bases his estimate of the flight of the American Golden Plover, is, I fear, but an example of the tremendous enthusiasm of this charming character for his subject.

But Gätke is not alone in over-estimating the velocity of flight. Many other writers have erred through basing a theory on bad evidence or no evidence at all, one of the most remarkable of these being Crawford ('Round the Calendar in Portugal'), who convinced himself that Turtle-Doves flew at such an astonishing pace that by leaving Kent at dawn they would be in Portugal a few hours later!

As regards more accurate data, it was my fortune during the recent war to have the opportunity of using anti-aircraft arrangements for my purpose. It was excellent practice for the men, and the results can be taken as accurate for all practical purposes. In conjunction with observations of an accurate nature from other sources, I have compiled the following table.

Unless the authority is stated in brackets, the observations are my own.

The following notes refer to the table:—

- NOTE A. Observations taken at Quetta by two persons with stop-watches over a measured distance varying from 400 to 660 yards. All birds were below 1000 feet, and in no case were they migrating.
- NOTE B. Observations taken in East Africa in the autumn of 1915 on migrants by using theodolites on a base of 1200 feet.
- NOTE C. Observations made at Dar-es-Salaam by a system of two persons with stop-watches stationed 440 yards apart and timing birds flying between points aligned by two stakes. All observations taken on still evenings when birds were flying to and from their breeding-grounds.
- NOTE D. Observations made near Rafa in southern Palestine during the autumn of 1917 by means of theodolites at two anti-aircraft gun-stations on a base of 3926 feet, the stations being connected by telephone.

NOTE E. Observations taken in southern Palestine by stop-watches at 440 yards distance and timing birds flying between two points aligned by posts.

NOTE F. Observations made near Montreuil in north-east France by means of theodolites on a 1420-foot base and small balloons to ascertain the velocity of the wind at the altitude of flight. All birds believed to be on migration.

Species.	Place.	Ground speed : m.p.h.	Remarks.
Ravens	S. Palestine.	32-39½	Eleven observations. Birds passing to and from roosting. Wind calm. Altitude of flight 310-840 feet. See note D. —
Rooks	N.E. France.	* 45	Taken with air-speed indicator from aeroplane. (R.A.F.)
Rooks	do.	39	Altitude of flight 1740 feet. Wind 17 m.p.h. side. See note F.
Rooks	do.	38	Altitude of flight 2120 feet. Side wind of 31 m.p.h. See note F.
Rooks and Jack-daws.	do.	40	Altitude of flight 690 feet. Slight side wind on ground. See note F.
Rooks	do.	39¼	Altitude of flight 2008 feet. Head wind 12 m.p.h. See note F.
Hooded Crow	Rossitten.	31·5	Average of observations on 20 birds. (<i>Thienemann</i> .)
Jackdaw	do.	39·6	Average on several birds. (<i>Thienemann</i> .)
Chough	Quetta.	11½	Very strong head wind. See note A.
Starling	do.	43-49	Thirteen observations. Wind calm. See note A.
Starling	S. Palestine.	45-48½	Twenty-two observations. Altitude of flight 120-325 feet. Wind calm. See note D.
Starling	Rossitten.	46·5	A single bird. (<i>Thienemann</i> .)
Rose-coloured Starling.	Quetta.	38, 40½	Two observations. Weather calm. See note A.
Finches	Rossitten.	33	Six observations. (<i>Thiene-mann</i> .)

* Air-speed.

Species.	Place.	Ground speed : m.p.h.	Remarks.
Crossbill	Rossitten.	37.5	Average of two observations. (<i>Thienemann</i> .)
Corn-Buntings ...	Palestine.	29½	Average of two observations. Birds flying to water. See note E.
Calandra Lark ...	do.	34	Average of three observations. Birds coming from water. See note E.
Red-throated Pipit.	East Africa.	26.5	Altitude of flight 210 feet. Wind calm. See note B.
Red-throated Pipit.	Palestine.	20¼	Birds coming to water. Average of two observations. See note E.
Pipits	Tuscar Rock.	20	(<i>Patten</i> , 'Zoologist.')
Wagtails	East Africa.	30.1	Altitude of flight 160 feet. Slight following wind. See note B.
Wagtails	do.	29	Altitude of flight 240 feet. Calm. See note B.
Swallow	France.	106	A Swallow was taken from Roubaix to Paris. distance 160 miles, and returned to Roubaix 90 minutes after its liberation. ('Zoologist,' 1887, <i>ex</i> 'Globe.')
Swallow	East Africa.	37¾	Altitude of flight 235 feet. Wind calm. See note B.
Swallow	do.	34	Flying at ground-level. Strong head wind. See note B.
Swifts	Mesopotamia.	well over 68	Large flock at 6000 feet, feeding over Mosul. They circled round machine and easily overtook it. Flying speed 68 m.p.h. (R.A.F.)
Roller	East Africa.	38.7	Altitude of flight 720 feet. Slight head wind. See note B.
Lanner Falcon ...	S. Palestine.	48	Bird not hunting. See note E.
Kestrel	East Africa.	40½	Altitude of flight 210 feet. Weather calm. See note B.
Kestrel	do.	43.9	Altitude of flight 310 feet. Weather calm. See note B.
Kestrel	do.	22	Altitude of flight 150 feet. Strong head wind. See note B.
Marsh-Harrier ...	Quetta.	31, 36	Observations on two males hunting. Weather calm. See note A.
Marsh-Harrier ...	S. Palestine.	37½	Single bird hunting. See note E.

Species.	Place.	Ground speed: m.p.h.	Remarks.
Lammergeier	Quetta.	79½	Gliding to food at angle of 12 degrees to horizontal. Strong side wind. See note A.
Lammergeier	Italy.	*110	Bird nose-diving to escape from a pursuing aeroplane. Observation taken with air-speed indicator. (R.A.F.)
White Stork	Mesopotamia.	*48	Birds on spring passage at 4200 feet over Baghdad. Birds drew in their necks and legs when machine was near. (R.A.F.)
Grey Heron	France.	under *45	By air-speed indicator. (R.A.F.)
Gannets	Eastbourne.	*48	By air-speed indicator. (R.A.F.)
Pelican	S. Palestine.	51	Altitude of flight 1240 feet. A side wind of 15 m.p.h. See note D.
Geese	?	44·3	Altitude of flight 905 feet. Measured by theodolite. (<i>Clayton</i> , 'Science,' n. s., vol. v. No. 105.)
Geese	France.	*55	By air-speed indicator. (R.A.F.)
Geese and Duck ...	Mesopotamia.	42-48,	Frequent observation by air-speed indicator. Birds usually on passage, but all below 3000 feet. (R.A.F.)
Geese	France.	50½	Altitude of flight 4210 feet. Head wind of 9 m.p.h. See note F.
Duck	?	47·8	Altitude of flight 958 feet. Measured by a special theodolite. (<i>Clayton</i> , <i>ibid.</i>)
Duck	Quetta.	51-59	Eleven observations. Wind calm. See note A.
Brent Geese	Scotland.	*45	By air-speed indicator. (<i>Wynne</i> .)
Mallard	?	*50	By air-speed indicator. Birds believed to be on passage. (<i>Wynne</i> .)
Mallard	France.	under *50	By air-speed indicator. (R.A.F.)
Teal	S. Palestine.	44	Single bird flying low and leisurely. See note E.
Houbara Bustard .	Quetta.	42½	A single bird. Wind calm. See note A.

* Air-speed.

Species.	Place.	Ground speed : m.p.h.	Remarks.
Stock Dove	S. Palestine.	42 $\frac{1}{4}$	Fairly strong head wind. Bird flying to water. See note E.
Turtle-Dove	Sinai.	37	Several tests made on birds flying their best alongside a train. Speed of train obtained from kilometre posts. No record of wind.
Sand-Grouse (<i>Pt. orientalis</i>).	Quetta.	43 $\frac{3}{4}$	Bird flying from water. Slight head wind. See note A.
Sand-Grouse (<i>Pt. senegallus</i>).	S. Palestine.	47 $\frac{1}{2}$	Bird flying from water. Altitude of flight 460 feet. Weather calm. See note D.
Pheasant	—	33·8	Experiment in covered gallery. ('Field,' Feb. 1887.)
Pheasant	—	38·1	Experiment in the open. ('Field,' Feb. 1887.)
Partridge.....	—	32·1	Experiment in the open. ('Field,' Feb. 1887.)
Partridge.....	—	*40	By air-speed indicator. (R.A.F.)
Quail	Mediterranean.	57	Timed at sea over 500 yards distance. Birds on passage. (<i>Lynes</i> , Brit. B. vol. iii.)
Geoffroy's Plover (<i>Ch. geoffroyi</i>).	Palestine.	34	Timed by speedometer in the Bay of Acre, birds flying directly in front of the car. Birds could be pressed up to 39 m.p.h., after which the car could overtake them. Wind calm.
Kentish Plover ...	do.	34	Same as for Geoffroy's Plover.
Caspian Plover (<i>Ch. asiaticus</i>).	East Africa.	51	Birds flying very low on passage. Wind calm. See note B.
Caspian Plover ...	do.	47	Birds flying at 480 feet. Strong side wind. Birds on passage. See note B.
Dotterel	S. Palestine.	45, 50 $\frac{1}{2}$	Two observations. Birds flying very low. Strong side wind of 11 and 21 m.p.h. respectively. See note D.
Golden Plover ...	England.	*60	Birds being pressed. By air-speed indicator. (<i>Wynne</i> .)

* Air-speed.

Species.	Place.	Ground speed : m.p.h.	Remarks.
Pacific Plover (<i>Ch. dominicus</i>).	Pacific.	50-75	Not founded apparently on accurate observation. (<i>Henshaw</i> , <i>Smithson. Inst. Rep.</i> 1910.)
Lapwing	S. Palestine.	37	Single bird, flying against head wind of 12 m.p.h. Altitude of flight 860 feet. See note D.
Lapwing	France.	50	Altitude of flight 5500 feet. Flying against a north wind on spring passage. Means of estimate unknown. (<i>Portal</i> , 'Field,' 17. iii. 17.)
Lapwing	do.	*40-45	Observation by air-speed indicator. (R.A.F.)
Lapwing	do.	42	Altitude of flight 1410 feet. Slight side wind at ground-level. See note F.
Little Stint	East Africa.	49	One observation. See note C.
Terek Sandpiper ...	do.	48-51	Four observations. See note C.
Greenshank	do.	46, 49	Two observations. See note C.
Marsh-Sandpiper ..	do.	48, 51, 51½	Three observations. See note C.
Oystercatcher ...	do.	45-49	Seven observations. See note C.
Curlew	do.	42-48½	Seventeen observations. See note C.
Whimbrel	do.	43-52	Nine observations. See note C.

* Air-speed.

So much for observations on the flight of wild birds. I shall now briefly record some of the more accurate observations on the rate of flight of Carrier Pigeons.

Tegetmeier declares ('Field,' 22. i. 87) that the average speed of Carrier Pigeons is 36 miles per hour, whilst on two occasions a speed of 55 miles per hour was maintained for four hours in succession.

From experiments carried out in a covered gallery ('Field,' 1887, p. 242) it was shown that a Pigeon flew at 33·8 miles per hour, whilst in the open another flew at 27·9 miles per hour.

In the 'Homing Fancier's Annual' of 1892 it was recorded that in covering 82 miles in good weather a bird maintained

just over 71 miles per hour. From the Scilly Islands to Wiltshire (215 miles) a bird kept up a speed of $50\frac{1}{2}$ miles per hour. In 170 miles a bird made 54 miles per hour, and in 104 miles it made $57\frac{1}{2}$ miles per hour. In a race from Bauff to Hampshire a bird maintained 62 miles per hour in very favourable weather. Finally, a celebrated bird called "Volonel" on two occasions maintained over 60 miles per hour.

Doubtless other figures have been published, but I have been unable to trace them. From the data available it appears that the normal velocity of a Carrier Pigeon is from 30-36 miles per hour, but that when "homing" they can attain up to 60 miles per hour or over. Again arises the question as to whether migrants can accelerate their speed when actually migrating, in the same manner that a "homing" Pigeon can hurry on its way when "homing." For reasons already given, I do not think they do, and there is certainly no evidence which even suggests it. The cases of Rooks in the above table were certainly those of migrating birds, and indicate no hurry. The Rossitten birds were all on passage, and show no excessive speed. In fact, the only excessive speeds we have in the table are those of the two Lammergeier which were taken under abnormal conditions, the Golden Plovers which were escaping pursuit, and the Roubaix Swallow. It is remarkable that this bird was also "homing," which may account for such an abnormal speed. But Swallows are most deceptive birds as regards their flight. They are in reality neither strong nor rapid fliers, and personally I do not attach too much reliance in the data of the Roubaix Swallow. I do not believe any Swallow is capable of anything approaching that speed unless assisted by a tail wind of 30 or 40 miles an hour, which, as is well known, is a hateful condition to a travelling bird.

The case of the Mosul Swifts is interesting. The birds were probably not on passage, but simply feeding. It is known that Swifts travel great distances in search of food and ascend great altitudes. In the Middle Atlas of Marocco, in the Himalayas, in Crete and Palestine, 4000 or 5000 feet

and 50 miles or so in distance seems nothing to these incomparable fliers. I have had splendid opportunities of observing both the Alpine, Common, and Spine-tailed (*Chetura*) Swifts, and it has been a great disappointment to me that I have never been able to get a satisfactory estimate of their rate of flight, as they never continue on an even course. On a small island off the coast of Crete, I was recently given a good exhibition of what an Alpine Swift can do. I was watching some of these birds feeding round cliffs in which several pairs of Eleonora's Falcon were about to breed. Now, this delightful Falcon is no mean flier, and as these Swifts passed their cliff, the Falcons would come out against them like rockets. The Swifts would accelerate, and seemed to be out of sight before the Falcons were well on their way. So confident were the Swifts in their superior speed, that every time they circled round the island they never failed to "draw" the Falcons, and seemed to be playing with them. I may add that these same Falcons have little difficulty in overhauling and striking a Rock-Pigeon—itsself no mean performer. I have also seen on record the case of Falcons and Swifts somewhere in India, when the former failed time after time to come up with his quarry. I unfortunately cannot trace the reference.

I hesitate to even guess at the speed to which a Swift can attain when the necessity arises, but the main point is that this, the fastest of birds, can increase his "feeding" speed of, say, 70 miles per hour to a velocity which must exceed 100 miles per hour. There is little doubt that the speed of the Golden Plover in the table is an accelerated speed. Pilots in Mesopotamia have told me that whereas Geese cannot to any great extent accelerate, Duck, when pressed, could attain a speed of about 60 miles per hour.

To conclude, I find that birds have two speeds—a normal rate which is used for every-day purposes and also for migration, and an accelerated speed which is used for protection or pursuit, and which in some cases nearly doubles the rate of their normal speed. Some of the heavier birds

can probably only accelerate to a slight extent. In this conclusion I am naturally excepting "courtship" flight, which is usually of an accelerated nature.

I also find, after eliminating abnormal conditions and observations based on meagre evidence, that the normal and migratory rate of flight in miles per hour is as follows:—

Corvidæ	31-45	Starlings	38-49
Smaller Passeres.	20-37	Falcons.....	40-48
Geese	42-55	Ducks	44-59
Tame Pigeons ...	30-36	Sand-Grouse ...	43-47
Waders 34-51, but mostly from 40-51.			

XIII.—*Field Notes on the Birds of Lower Egypt.* By W. RAW, M.B.O.U. *With Contributions by Colonel R. SPARROW, C.M.G., D.S.O., M.B.O.U., and the Rev. F. C. R. JOURDAIN, M.A., M.B.O.U.*

FROM August 1915 until April 1919 I was resident at the Wireless Station of Abu Zabal. The village of that name is situated some twenty miles north-east of Cairo, and my quarters were a further mile in the same direction, right on the Cairo-Ismailia canal, where it skirts the edge of the desert. Thus I had easy access to the cultivation, desert, and palm-groves, while some two hundred acres of useful swamps (known as the Birket Accrashi) were within half-an-hour's walk. The locality was therefore ideal for ornithological observation.

Throughout my stay I kept a daily diary, and the following notes are culled from its pages. I endeavoured to secure as much information on the breeding birds of Egypt as I could, and for the purpose of putting my observations and other information on record, I propose to include all my oological data in this paper, although much of it was secured outside the six-mile area included in the Abu Zabal district. Due reference will be made to such divergence.

To my friend Mr. J. Lewis Bouhote, M.A., F.L.S., F.Z.S.,